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Abstract

THE DEVELOPMENT OF NUCLEAR ENERGY IN RELATION TO THE RESERVES OF NUCLEAR MATERIALS

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Many detailed studies have been made about the cost price of nuclear energy. Particularly the fuel cycle costs often have been discussed in detail, However, the influence of the cost price of the nuclear materials, either natural uranium or thorium as a function of the amount available for that price is seldom taken into consideration. Furthermore, although the necessity of breeder reactors for a future large scale nuclear energy production is often stressed, the influence of the cost price of the first nuclear charge is frequently neglected.

In this paper the material requirements for start up and operation of a future large scale nuclear program of nuclear power plants for electricity production are discussed, using the following assumptions:

1. From 1970 - 2000 about 50% of the newly installed electric production capacity will be nuclear;
2. The doubling time of the installed capacity will be 12 years in the period 1962 - 2000;
3. The load factor of the nuclear power stations will be 75%.

Using raw nuclear material reserves from estimates of the U.S.A.E.C. and Euratom, the investment and consumption of nuclear materials is discussed for present day power reactors, high conversion reactors and fast or thermal breeder reactors.

The following results obtained need to determine the

future development and application of nuclear energy:

1. The consumption of nuclear materials in present day power reactors, either enriched or not, is so inefficient that with these reactors the presently known supply of natural uranium at prices up to 5 times the current price will be wasted by 1983.
2. The expenditure of uranium and thorium in breeder reactors is so efficient, that even very expensive nuclear materials abundantly available, can be used.
3. If Pu is produced in present day power reactors as a start up charge for breeders, two or three times more natural uranium will be required for this Pu-production, than by using U-235 which is produced in a diffusion plant as a start up charge.
4. For the first start up charge of breeder reactors the use of rather cheap natural uranium as the primary material, will be required to prevent an excessive capital investment.
5. In fast breeder reactors the start up charge of fissile materials is two or three times higher than in thermal homogeneous breeder reactors.
6. In high conversion heavy water reactors at least the nuclear equivalent amount of Pu can be produced as the amount of U-235 to be extracted from the same quantity of natural uranium.

The conclusions from these results are:

1. Prospection for cheap uranium resources is urgent;
2. The development of breeder reactors is essential for the future of nuclear energy;
3. It is undesirable to use present day power reactors in large numbers;
4. High conversion heavy water reactors can be accepted for an intermediate period, if breeder reactors are not yet sufficiently developed.